

Former Williams Air Force Base
Standard Operating Procedure No. 8
for
Water Level Measurements, and Non-Aqueous Phase Liquid Removal

Prepared by:



AMEC Foster Wheeler
Environment & Infrastructure
4600 East Washington Street
Phoenix, Arizona 85034

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
BTOC	below top of casing
ft	foot, feet
LNAPL	light non-aqueous phase liquid
SOP	standard operating procedure

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the methods for conducting water level measurements in monitoring wells during field investigations at hazardous and non-hazardous waste sites and when necessary, removal of light non-aqueous phase liquid (LNAPL) from wells.

1.1 Objective

The objective of water level measurements is to gain accurate measurements (to within 0.01 feet [ft]) of the depth of ground water for use during well installation, in the recording of data for the preparation of ground water elevation contour maps, purge volume calculations during ground water sampling, and aquifer testing. The objective of LNAPL removal is to safely and to the extent possible, remove LNAPL from the subsurface as a means of mass removal and to facilitate groundwater quality sampling.

2.0 METHODS

Water levels will be measured while the water level is stable (static water level measurement) and while the water level is changing (continuous water level measurement). The following methods will be used measure the water level.

2.1 Static Water Level Measurement

Static water level measurements will be used during well installation, in the recording of data for the preparation of ground water elevation contour maps, and purge volume calculations during ground water sampling.

2.1.1 Equipment

The following list of equipment may be utilized during water level measurements. Site-specific conditions may warrant the use of additional or deletion of items from this list.

- Electronic water level indicators with a minimum resolution of 0.01 ft. A dedicated electronic water level indicator has been assigned to all sites at Williams Air Force Base (AFB) where water levels are collected. This sounder is marked with the identification of “Dedicated AFB Sounder”, and should be used as the primary device to measure all Williams AFB sites, unless it becomes inoperable, at which time a back-up and recently calibrated sounding device may be used until the dedicated device can be repaired and placed back into service. Calibration of the electronic water level indicator is not required unless it has been damaged or is not functioning;
- Potable water;
- Alconox, liquinox or other non-phosphate concentrated laboratory grade soap;

- Deionized water;
- Pump sprayer;
- Pint squeeze bottles;
- Any necessary personal protective equipment (gloves, eyewear, tyvek suits);
- Air monitoring instruments as required in the site-specific Health and Safety Plan;
- Field logbook;
- Well keys;
- Previous measurement data (if available);
- Oil/water interface probe (if necessary); and,
- An engineer's ruler\
- Free product bailer
- Clean five gallon bucket
- 5 gallon or smaller diesel safety can
- 100 gallon or smaller metal diesel transfer tank

2.1.2 Procedure

The following procedures should be followed during water level measurements. Procedures may vary depending on the equipment used and contaminants present at the site.

Site specific conditions may warrant the use of stringent air monitoring and potentially more significant decontamination scenarios.

1. Inspect the sounder prior to each use to ensure proper battery function and tape integrity. Replace battery if necessary. Check that the water level tape has no obvious kinks or damage. If the tape is improperly marked or appears damaged do not use it. Find a suitable replacement and proceed with the inspection process. The damaged sounder shall be tagged with the type of damage clearly indicated. The sounder shall then be sent to a qualified vendor for repairs or replacement. All inspection activities shall be documented in the field notebook or equipment inventory list.
2. Record the condition of the well (protective casing, concrete collar, lock in place etc.).
3. Put on latex or other sterile gloves. Stand upwind of the well; unlock and open the well. If a vented cap is present, conduct well mouth air monitoring from the vent. If a non-vented well cap is present, remove the cap and monitor the well mouth immediately. Record all pertinent air monitoring results (sustained, dissipating, background, odor).

4. After opening the well, allow its internal pressure to equilibrate for at least five minutes prior to measuring the water level.
5. Identify the previous measuring point marking or notch on the riser or casing (if present). Record this location in the field logbook or on the water level monitoring form (see SOP No. 02, *Field Documentation*).
6. Using a previously decontaminated water level indicator, turn on the meter, check the audible indicator, reel the electronic probe into the well riser (with the increments visible) slowly until the meter sounds, grasp the tape with hand, withdraw the tape and lower it again slowly until the sound is again audible. Check the depth to water on the tape and make a mental note of the depth to within 0.01 ft. Lower the probe again slowly and repeat the measurement for accuracy. A one-ft error is the most common measurement type during water level measurements. Be sure to read the depth correctly on the tape.
7. Record the depth to water from the measuring point in the field logbook or on the water level monitoring form.
8. Procedures utilized during water level measurements where light non-aqueous phase liquid (LNAPL) products are floating on the water table will be modified to include the use of the oil/water interface probe. The procedures for using this probe will be consistently implemented in accordance with manufacturers' specifications and operating procedures. Through the use of this probe, product thickness will be determined (see example calculation below):
 - Depth to groundwater measured = 100 ft below top of casing (BTOC)
 - Depth to top of LNAPL = 99 ft BTOC
 - Thickness of LNAPL = Depth to groundwater (ft BTOC) – depth to top of LNAPL (ft BTOC) = 100 – 99 = 1.0 ft.
9. If the LNAPL thickness is calculated to be greater than 0.10 ft, then the well shall not be sampled. If LNAPL thickness is greater than or equal to 1.0 ft, then the LNAPL shall be bailed or pumped out of well following the procedures in section 2.1.3 and 2.1.4, as well as safety guidelines in the applicable AHA's.
10. Decontaminate the probe and any obviously soiled tape. Refer to SOP No. 01, *Equipment Decontamination* for equipment decontamination.

2.2 LNAPL Removal

2.2.1 Bailing LNAPL from Wells

1. Follow procedures above for water level measurements and safety guidelines in the AHA – Well Level Reading & Bailing Free Product.
2. Keep flame sources away from well. Use caution tape or cones to keep pedestrians away if necessary.

3. Inspect bailing equipment. Ensure that free product bailer is in good condition and clear of debris that could keep the ball from sealing. If using a drill adapter to raise and lower bailer, look at and test drill to insure that it is in proper working condition before applying the bailing adapter. Insure that the bailing adapter is in good condition and secured to the drill.
4. Lower bailer into well with rope or string until it reaches the product in the well, this will be indicated by reduced pull on the string. Allow the bailer to sink into the free product and fill up. Retrieve bailer from well smoothly to prevent unseating the bailer ball seal. If using a drill, operate slowly to prevent product from spilling when it reaches the surface.
5. Empty bailer into a clean 5 gallon bucket by unseating the ball at the bottom of the bailer. Don't overfill the container. Fuel shall be transferred to a 5 gallon or smaller diesel safety can for transportation.
6. Continue to bail product from the well until the bailer comes up empty.
7. Measure and record water/product level again and check for LNAPL thickness. If LNAPL thickness is still greater than 1.0 ft, check for debris that could be keeping the bailer ball from sealing and continue bailing.
8. Seal top of containers filled with bailed LNAPL and secure for transportation. Transport free product to ST012 containment system. Dispose of product in an appropriate manner. Place remaining free product in the LNAPL tank or a metal drum with a lid. Consult ST012 system operators if product is to be placed into any ST012 SEE system LNAPL tanks.

2.2.2 Pumping LNAPL from Wells

1. LNAPL shall be pumped from the well if there is greater than 4 feet of product below the pump intake. Pump LNAPL from wells when a pump designed for operating in free product is installed (this SOP does not address LNAPL recovery pump installation due to multiple types and configurations of pumps available). Follow procedures above for water level measurements and safety guidelines in the AHA – Well Level Reading & Bailing Free Product.
2. Use sounding tube to measure water/product level. Leave interface probe at water/product interface to track product level. Ensure that LNAPL is below pump intake at all times while operating pump to prevent water from collecting in fuel tanks. LNAPL shall be pumped into a 100 gallon or smaller metal diesel refueling tank designed and intended for installation in the bed of a pickup truck.
3. Remove all ignition sources and secure the area. Place barricades, cones, or caution tape if necessary to keep unauthorized personnel out of area.

4. Inspect equipment and tubing for defects or damage. Check level in fuel tank to prevent overflow during pumping.
5. Install grounding wires to prevent static discharge. If LNAPL tank is installed on a vehicle connect grounding wires from truck to grounding rod.
6. Connect tubing from pump to LNAPL tank. Keep valves closed. Secure tubing to fuel tank to prevent spillage.
7. Connect pneumatic supply tube from air compressor to pump. Keep valve closed.
8. Keep air compressor clear from fuel lines, tank, and fumes. Start air compressor. Use regulator to operate pump at appropriate pressures. Do not allow pressure to exceed equipment manufacturers recommended pressure.
9. Open pump valves to allow fuel to flow to tank. Open pneumatic supply valve from air compressor to pump. Monitor fuel flow into tank, fuel level in tank, air compressor pressure, and water/product interface level in well during pumping.
10. Shut off valve to pneumatic supply when water/product interface reaches within 0.10 ft of pump intake or if product level is below intake. Shut off fuel pump valves. Turn off air compressor. Drain remaining fuel in hose into the fuel tank. Cap the ends of the hose to prevent spillage. Remove pneumatic supply tubing and grounding.
11. Measure and record depth to product and depth to water. Retrieve interface probe and install cap on sounding tube. Secure well vault cover.
12. With the vehicle on level ground measure and record LNAPL level in fuel tank using interface probe. Check for water at bottom of fuel tank. Remove interface probe and secure cap on fuel tank.
13. Transport free product back to ST012. If fuel tank needs to be emptied consult with ST012 system operators for disposal. Use the fuel transfer pump on the tank to pump product from tank. Transfer remaining free product to the LNAPL tank or the designated metal LNAPL storage drum and record both the volume transferred and the total volume of LNAPL stored on site in field notes.

2.3 Continuous Water Level Measurement

Continuous water level measurements will be used during aquifer testing such as slug tests, step tests, and pump tests.

2.3.1 Equipment

Equipment that will be used for continuous water level monitoring includes, but is not limited to, the following items:

- Manual water level meters, pressure transducers, and data loggers;
- Decontamination equipment;
- Equipment to shelter the data logger (if required by conditions);
- Portable computers and data media;
- Communication cables for data linking;
- Stopwatch;
- Logbook;
- Recording barometer (if required by conditions);
- Operating manuals for data logger and/or pressure transducers; and,
- Hand-held radios and/or cellular telephones.

2.3.2 Continuous Water Level Monitoring Procedures

General procedures, pre-test and post-test activities, and the specific activities for the test are specified below.

2.3.2.1 Pre-test/Post-test Activities and General Procedures

The general procedures for pre-testing and post-testing activities are as follows:

- All down-hole intrusive equipment (e.g., pressure transducers and water level monitoring devices) must be decontaminated before and after use as per SOP No. 01, *Equipment Decontamination*;
- Pressure transducers and data loggers should be calibrated and tested before actually using them in the test program. The operational integrity and the configuration of the data logger should be tested by running an inherent self-test program in the unit. Pressure transducers are calibrated by the manufacturer prior to shipment. Pressure transducers should be connected to the data logger and checked for operation by placing the pressure transducer below the water table at a known depth and taking a reading, moving the pressure transducer and taking another reading. During field checking of factory calibration, the expected water level must match the transducer recorded water level by less than one percent of the depth. Testing information will be recorded in the field notebook. If the transducer does not appear to recording properly, it will be sent back for replacement;
- Pressure transducers should be assigned to individual monitoring well locations for the duration of the test;

- All time recording devices should be synchronized to a master clock before the test;
- Water levels in all wells should be taken manually, just before beginning any test; and,
- All data and events will be recorded in logbooks or on data sheets specified for the recording of data.

2.3.2.2 Field Installation

- Pressure transducers should be lowered gently down the well and should be installed below the lowest anticipated change in water level, but not so low that the range of the transducer might be exceeded at the highest anticipated change in level; and,
- Pressure transducers should be secured in place and allowed to stabilize for approximately one hour prior to initiating programmed data collection to insure accuracy of measurements.

2.3.2.3 Test Activities

- As back-up to data logger or transducer failure, downloads of partial data from the automatic data recorders should be made periodically; and,
- In addition, manual water level readings will be conducted periodically throughout the test. Manual water level readings may disturb the water column.

The time that the manual reading was taken should be recorded and referenced with the reading collected by the data logger. Manual water level measurements are a required part of the test as a periodic backup in the event of data logger or transducer failure and to provide quality assurance/quality control data.